STS Hydropower, LLC
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Bethesda, Maryland 20814

VIA EMAIL

October 1, 2020

Mr. Kyle Alexander
Kalamazoo District Supervisor
Kalamazoo District Office
Michigan Department of Environment, Great Lakes, and Energy

Re: Morrow Lake and the Kalamazoo River Downstream of Morrow Dam – Draft Field Investigation Plan

Dear Mr. Alexander:

STS Hydropower, LLC (STS) has prepared this draft Field Investigation Plan (FIP) for sediment investigations of the Kalamazoo River immediately upstream and downstream of the Morrow Dam. The specific activities described in this draft FIP are in response to Violation Notices, dated July 8, 2020 and September 16, 2020 (Violations), issued by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) in connection with the partial drawdown of the Morrow Lake reservoir for emergency repairs on the Morrow Dam. EGLE stated that STS must develop a plan to assess the volume, location, depth and composition of sediments downstream that were mobilized by the drawdown of Morrow Lake and to sample those sediments for PCBs and hydrocarbons. In accordance with the sampling and testing commitments STS made to EGLE in its written responses to the Violations dated August 7, 2020, August 21, 2020, and September 23, 2020, STS is providing this draft FIP for EGLE review and approval. The purpose of this draft FIP is to identify areas where there have been a significant accumulation of sediments in the River compared with historical levels and to assess certain chemical constituents in sediments in those areas (*i.e.* PCBs and hydrocarbons) to evaluate potential source areas. As more particularly described below, STS will begin work to immediately implement portions of this FIP and will proceed with the remainder of the work described in the plan upon consultation with EGLE.

This draft FIP presents a description of the proposed monitoring techniques and activities; the types and locations of any soil, sediment, floodplain soils and water samples to be collected; the rationale for those samples; and the physical and chemical parameters to be measured in the samples.

A more detailed work plan that describes the specific field and laboratory methods (if any) to be followed (Field Sampling Plan) and the quality assurance/quality control measures that will be applied to the work (QA/QC Plan) will be provided to EGLE for review at a future date.

Introduction

STS began the drawdown of the Morrow Lake reservoir in November 2019 after its engineering contractor determined that the deteriorated condition of the Morrow Dam spillway gates warranted an immediate emergency partial drawdown to remove pressure from the gates and eliminate the risk of an uncontrolled flooding event that posed a considerable risk for public health and safety. After the drawdown was complete, a detailed inspection determined that the gates were in a much more deteriorated state than previously anticipated and that a full replacement of the existing gates was necessary. Although the drawdown was initially anticipated to last for a period of at least four months, the need for the full gate replacement work will require the drawdown period to continue until December 2020 when the work is anticipated to be completed.

Following the drawdown, EGLE informed STS of reports of increased turbidity and some fine sediment deposits along the Kalamazoo River downstream of the dam. The sediment of concern is typically a dark-colored mixture of silt and clay that is similar to sediment deposits in the lake near the dam. EGLE issued the Violations based on these reports. In response, STS has installed 2,100 feet of sediment curtains upstream of the dam and 1,100 feet of sediment curtains downstream of the dam to mitigate turbidity and is currently evaluating additional control measures as more particularly detailed in its letter to EGLE dated September 23, 2020.

STS also proposes this draft FIP to perform the tasks described below to provide additional information regarding the sediment in Morrow Lake upstream of the dam and any sediment deposits in the downstream portion of the Kalamazoo River between Morrow Lake Dam and Allegan Lake that are likely the result of the Morrow Lake drawdown (collectively, the

Study Area). The draft work plan focuses on the location, quantity and composition of such sediment deposits and determining whether any significant amount of that sediment was deposited, compared with historical levels, and remains downstream of the dam, as well as the physical (*e.g.* grain size distribution) and chemical composition of those sediments.

Objectives of Proposed Sampling and Analysis

The following are the principal objectives of the sample collection and analysis activities described below in Task 2.

1. Establish the present-day baseline composition of the River sediment in the Study Area both upstream and downstream of the Morrow dam.
2. Compare current sediment conditions to historical conditions (as determined by prior investigations) to determine whether there have been significant changes downstream of the Morrow dam.
3. To supplement any sediment transport assessment with chemical data as a check of the source of new sediment accumulation. Specifically, this assessment will evaluate whether the chemistry (*e.g.*, hydrocarbons and PCBs) of sediment in potential source areas (*e.g.*, the upstream channel bank) is the same as recent deposits of sediment downstream of the Morrow dam.

Methods and Materials

Field activities, water quality monitoring, sediment sample collection, laboratory analysis, quality assurance and quality control, and data assessment will conform to the requirements of the Multi-Area Field Sampling Plan and Quality Assurance Project Plan for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site, as appropriate (see References section).

Scope

Task 1. Remote Sediment Identification

STS will generate Total Suspended Solids (TSS) and turbidity density maps of the Study Area using water quality samples and dove satellite imagery as described in Appendix A. The maps will be created from analysis of pre-drawdown and post-drawdown satellite imagery and

will be used to guide Task 2 – Field Sediment Identification activities. Water quality data from field-deployed buoys will be used to calibrate the analysis. STS will examine pre- drawdown imagery to establish baseline TSS and turbidity of the Study Area. STS will analyze post-drawdown imagery to generate TSS and turbidity maps representative of current sediment conditions related to the drawdown in the Study Area.

Assumptions

- STS will select water quality readings from field deployed buoys (which acquire data every 10 minutes) or other field-collected water quality data, whichever was measured nearest to the time of satellite imagery capture and closest in location to the Study Area to ensure a strong temporal and statistically valid data correlation to be extrapolated throughout the project area.
- The pre-and post-drawdown map comparison is only intended to:
    - Provide preliminary, interim information regarding the location and extent of sedimentation that may have occurred as a result of Morrow Lake drawdown in November 2019.
    - Identify locations for field investigations in Task 2.
- Multiple imagery collection events may be examined to increase sample size to account for seasonal, storm-driven, and other variations for the purpose of generating a reliable approximation of sedimentation related to the November 2019 drawdown.

Deliverables

Total Suspended Solids (TSS) and turbidity density maps of the Study Area will be generated.

Task 2. Field Sediment Identification - Location Field Validation, Measurement, and Testing

Following remote-sensing identification of potential sediment deposits, STS will inspect the locations in the field to verify the location and extent of any potential drawdown-related sediment and obtain samples of such sediment for laboratory analysis. STS's consultants will:

- Travel to each site on the map identified as having "High Turbidity" and "High TSS" and verify the presence of sediment.

- Visually inspect and manually probe the sediment with a metal rod, including measuring sediment depth and area to refine the approximate extent (limits) and estimate a quantity.
    - At selected suspected deposition locations identified in Task 1, where a soft sediment layer is found above a more dense layer by manual probing, a sediment core will be collected to calibrate the manual method. The cores will be logged in the field. Then, the extent and depth the of soft sediment in that area will be determined by additional manual probing.
- Obtain a sediment sample at some sites for laboratory analysis to identify:
    - Material classification (i.e.-percent of silt, clay, sand, gravel, cobble, boulder).
    - Presence of hydrocarbons and PCBs.
- The material classifications and chemical compositions of sediments from suspected deposition locations downstream of the dam will be compared to those from upstream of the dam and to sediment that has accumulated on the surface of the articulated concrete block shoreline of Merrill Park. The new sediment at Merrill Park likely appears to be representative of deposition since the Morrow dam drawdown.

Assumptions

- Extent (limits, boundary) of sediment deposits and the locations of any sediment samples collected for analysis will be recorded using handheld GPS.
- Sediment samples will be collected for chemical analysis from the 0 to six inch interval using hand tools on River or Lake banks and in areas of exposed sediment, and using a grab sampler for sediment below water. At those locations where sediment cores are advanced, a sediment sample will be collected from the 0 to six inch interval and from the sediment below the soft sediment, if possible.
- Five sediment samples will be randomly collected from identified depositional areas; however, sampling will only extend as far downstream in the Study Area as indicated in maps and verified in field. An additional five sediment samples will be collected downstream of the dam based on engineering judgement as per the rationale shown in Table 1. Finally, up to 10 sediment samples, covering Morrow Lake, the eroded channel bank areas, and the accumulated sediment at the dam, will be collected and analyzed.

This sampling scheme should be sufficient to cover the potential sediment source areas, and provide sufficient chemical data to assess the site-specific variability and support simple statistical comparisons to pre-drawdown conditions.

- Proposed sediment locations and rationales are provided in Table 1. The locations and total number of samples will be increased as needed based on information gathered as part of Task 1.
- All samples will be analyzed for PCBs as Aroclors (EPA 8082A), total organic carbon (TOC), total petroleum hydrocarbons (TPH; modified for oil spill identification)(EPA 8015M), and particle size distribution. Portions of the samples will be frozen by the laboratory and stored for six months as contingency for potential future analyses.

Data Validation

Laboratory data will be validated by a third party according to the US EPA National Functional Guidelines.

Task 3. Sediment Report

STS's consultant will prepare a technical memorandum (TM) summarizing Tasks 1 and 2, including the data collection methodology, results, and interpretation. STS also will include recommendations for any additional assessment and monitoring, if such are indicated.

At a minimum, the TM will include:

- Updated density maps (from Task 1) with field-verified sediment deposit locations.
- Table of sediment data, including quantity, location, classification, and concentrations of hydrocarbons and PCBs.
- GIS maps of chemical data.

Field Sampling Plan

In order to maintain consistency and for comparison with other downstream sediment investigations, all field work will be conducted according to the Multi-Area Field Sampling Plan for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site, Revision 1, October

2007, together with appropriate additions and modifications to be described in the Field Sampling Plan to be prepared by STS and submitted to EGLE for review as described above.

QA/QC Plan

In order to maintain consistency and for comparison with other downstream sediment investigations, all field and laboratory work will be conducted according to the Multi-Area Quality Assurance Project Plan for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site, March 2010, together with appropriate additions and modifications to be described in the QA/QC Plan to be prepared by STS and submitted to EGLE for review as described above..

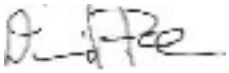
Schedule

We are immediately taking steps to implement the work described in Task 1. We anticipate collaborating with EGLE staff on the substance of this FIP on our regularly scheduled calls regarding the gate replacement project. Our schedule for implementing Task 2 work will be guided by that collaboration and EGLE's approval of FIP scope and methods. We anticipate completing Task 2 and Task 3 in Fall 2020.

* * * * *

If you have any questions regarding this draft FIP please do not hesitate to contact me at 202.724.8765 or via email at David.Fox@EagleCreekRE.com. Alternatively, you may contact Melissa Sonnleitner at 920.293.4628 or via email at Melissa.Sonnleitner@EagleCreekRE.com.

Sincerely,



David H. Fox
Director, Licensing and Compliance
STS Hydropower, LLC

References

ARCADIS. 2010. Multi-Area Quality Assurance Project Plan for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site, Revision 1. March 2010.

ARCADIS BBL. 2007a. Multi-Area Field Sampling Plan for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site, Revision 1. October 2007.

ARCADIS BBL. 2007b. Multi-Area Health and Safety Plan for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site. May 2007.

Table 1. Sediment Sample Locations and Rationales

Identification	Location	Rationale
EC-SD-01	RM 40	Upstream of the Allegan dam; most downstream extent of the Study Area
EC-SD-02	RM 50	Coverage
EC-SD-03	RM 60	Coverage
EC-SD-04	RM 65	Coverage
EC-SD-05	RM 71	Just downstream of confluence with Portage Creek
EC-SD-06	RM 76	Just downstream of the Morrow dam
EC-SD-07	RM 75	Depositional area
EC-SD-08	RM 74	Depositional area
EC-SD-09	RM 73	Depositional area
EC-SD-10	accumulated sediment behind the spillway gates and forebay	Characterize sediment just upstream of the dam
EC-SD-11	accumulated sediment behind the spillway gates and forebay	Characterize sediment just upstream of the dam
EC-SD-12	accumulated sediment behind the spillway gates and forebay	Characterize sediment just upstream of the dam
EC-SD-13	Morrow Lake	undisturbed area immediately adjacent to areas of obvious erosion and transport
EC-SD-14	Morrow Lake	undisturbed area immediately adjacent to areas of obvious erosion and transport
EC-SD-15	Morrow Lake	undisturbed area immediately adjacent to areas of obvious erosion and transport
EC-SD-16	Morrow Lake	Coverage
EC-SD-17	Morrow Lake	coverage
EC-SD-18		Contingency
EC-SD-19		Contingency
EC-SD-20		Contingency
EC-SD-101		Field duplicate
EC-SD-102		Field duplicate

Appendix A

Remote-Sensing Background and Methods for Sediment Identification

Stantec remote-sensing scientists generate Total Suspended Solids (TSS) and turbidity density maps using water quality samples and dove satellite imagery. These density maps can be used to identify potential areas of sediment accumulation and guide field data collection.

Dove satellites are small, inexpensive, and easier to launch into orbit than traditional large, expensive satellites. Dove satellites form constellations and working as a team can collect high resolution imagery for the entire Earth's surface every day. Dove satellites allow Stantec to retroactively select historical imagery taken at numerous specific times, such as dates when water quality samples were collected. This enables calibrated analysis of the imagery and extrapolation to a larger area of interest. Dove satellites represent state-of-the-art technology for this type of historical comparison and calibration, level of detail, and spatial coverage.

Dove satellite imagery consists of 4-channels; blue (455-515 nm), green (500-590 nm), red (590-670 nm), and near infrared (NIR) (780-860 nm) at 3.5-m ground sampling distance (Figure 1).

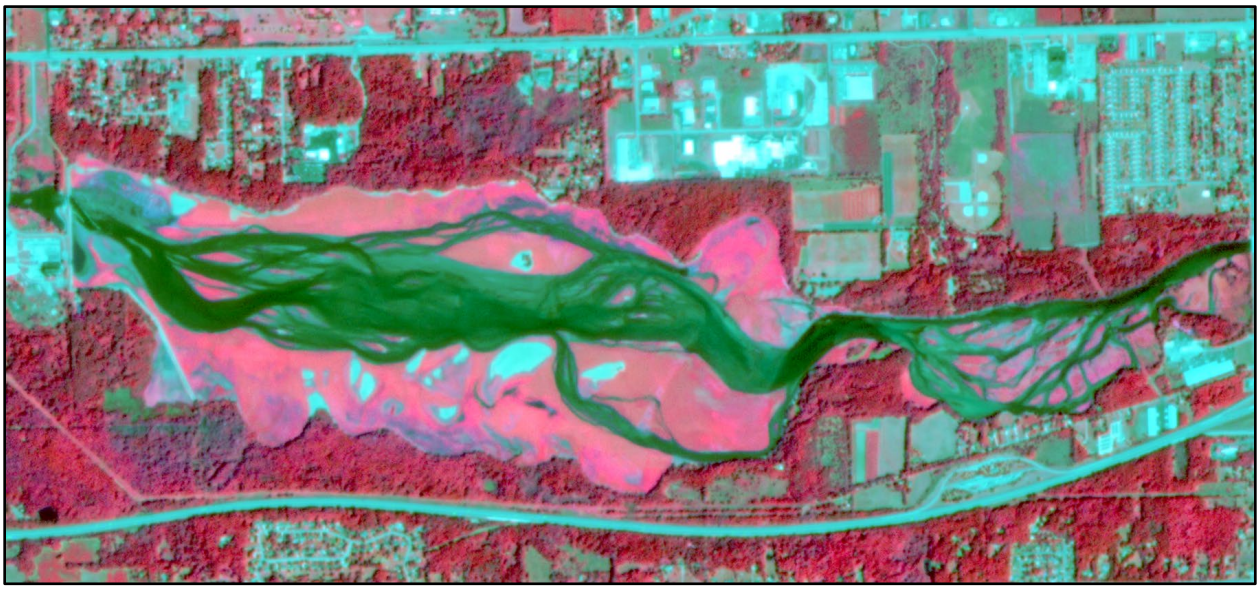


Figure 1. Example of dove satellite image in false color composite (NIR, Red, Blue, and Green) of Morrow Lake, MI, captured August 11, 2020.

Stantec will acquire dove satellite imagery prior to the Morrow Lake drawdown to establish baseline TSS and turbidity of the study area. We will then acquire additional imagery, including images captured during times that correspond to water quality data collection activities, and generate TSS and turbidity maps that reflect current conditions.

The maps will be created by analysis and calibration of the 4 channels in the dove satellite imagery. We will generate statistical relationships between (1) field collected water samples of TSS and turbidity from the deployed buoys and/or other water-quality samples and (2) spectral reflectance readings of each of the imagery wavelength channels. This process allows us to extrapolate water quality values reliably and accurately throughout the study area. We will also calculate band ratios from satellite imagery channels to create a Normalized Difference Turbidity Index (NDTI) and a TSS index. This will isolate water properties and further refine the statistical correlation between field collected TSS and turbidity values and imagery readings (Figure 2).

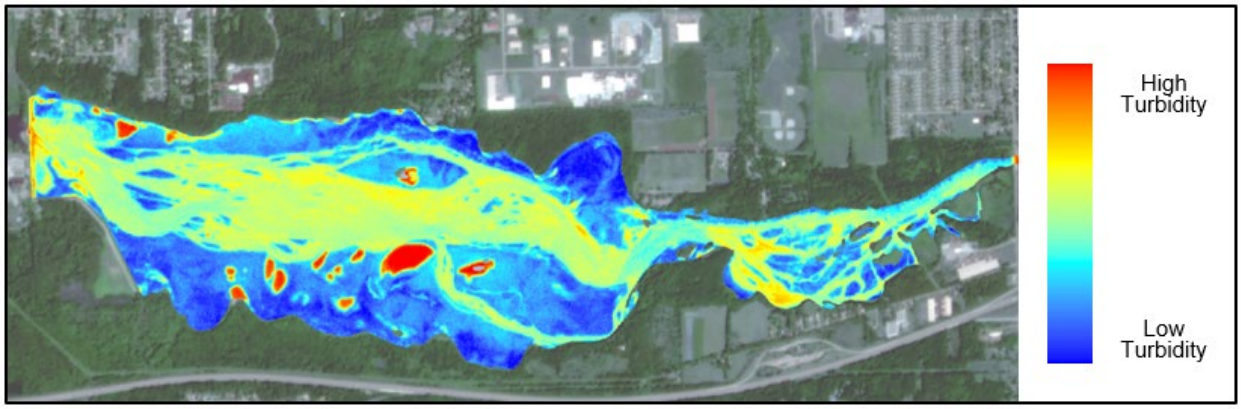


Figure 2. Example of Normalized Difference Turbidity Index of Morrow Lake calculated from the August 11, 2020 dove satellite image showing high (red) and low (blue) levels of turbidity.

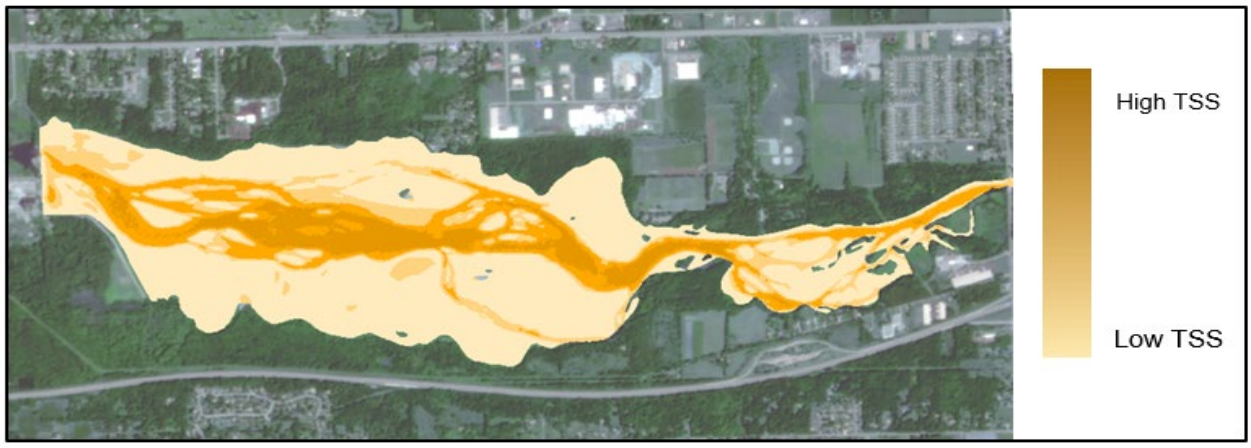


Figure 3. Example of TSS index of Morrow Lake calculated from the August 11, 2020 dove satellite image showing high (brown) and low (beige) levels of TSS.